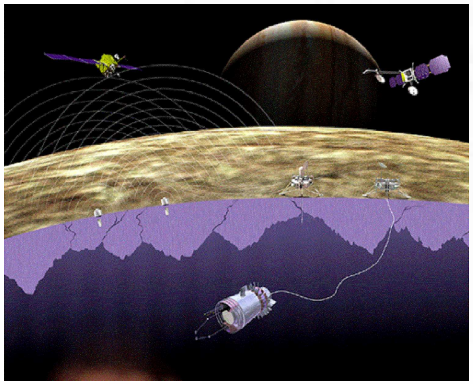
Mission and Science Measurement Technology

Strategic Theme Objectives

- **Mission Risk Analysis**

Develop the capability to assess and manage risk in the synthesis of complex systems.



- **Science Driven Mission Architectures and Technology**

Define new system concepts and demonstrate new technologies that enable new science measurements.

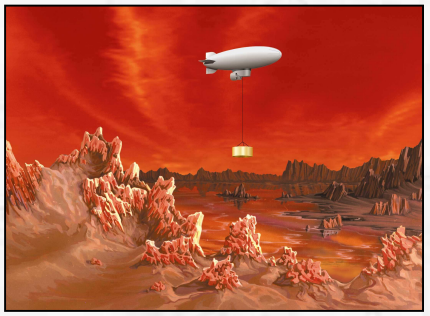
- **Create Knowledge from Scientific Data**

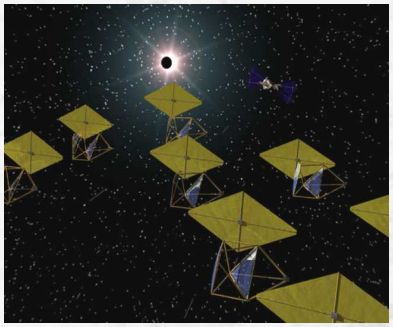
Develop breakthrough information and communication systems to increase our understanding of scientific data and phenomena.

Mission and Science Measurement Technology

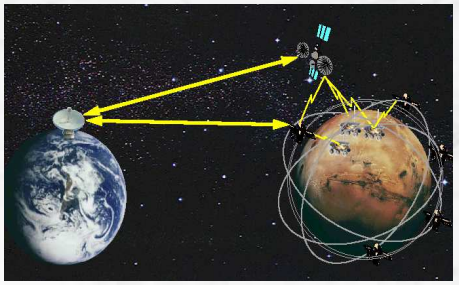
Key Challenges

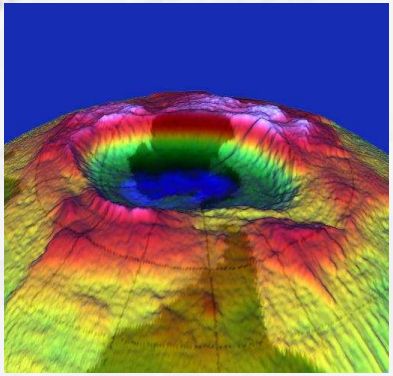
- Enabling new science measurements in remote locations and extreme environments





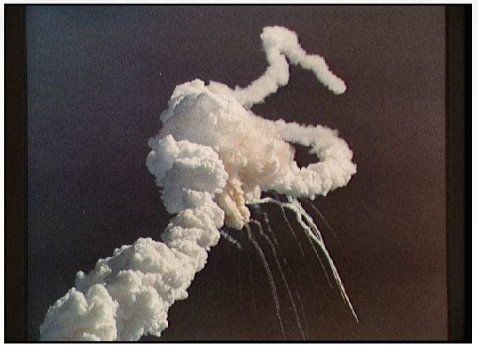
- Returning large volumes of scientific data and extracting useful information





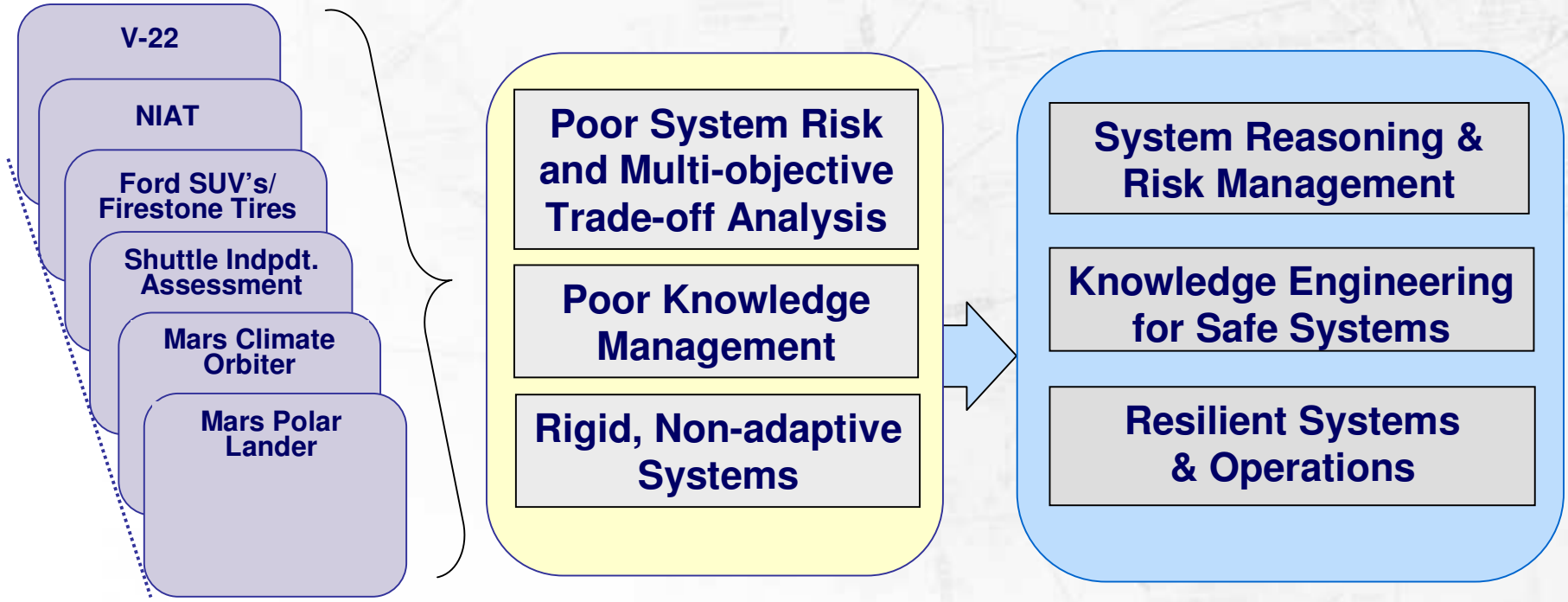
- Ensuring the success of future missions by predicting and reducing risk

Mars Polar Lander Mishap



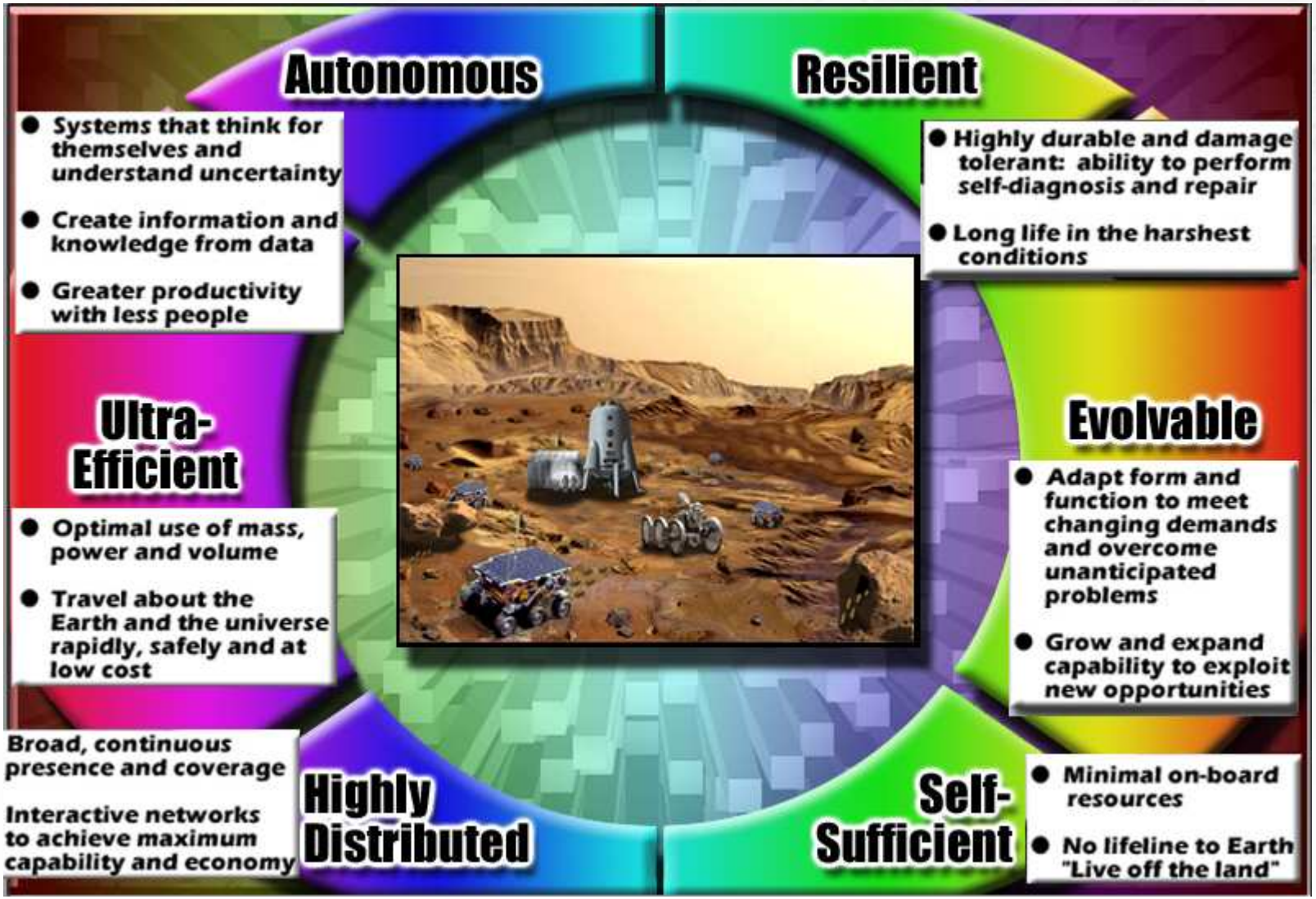
Challenger Mishap

Agency/Industry Risk Assessments



Mission and Science Measurement Technology

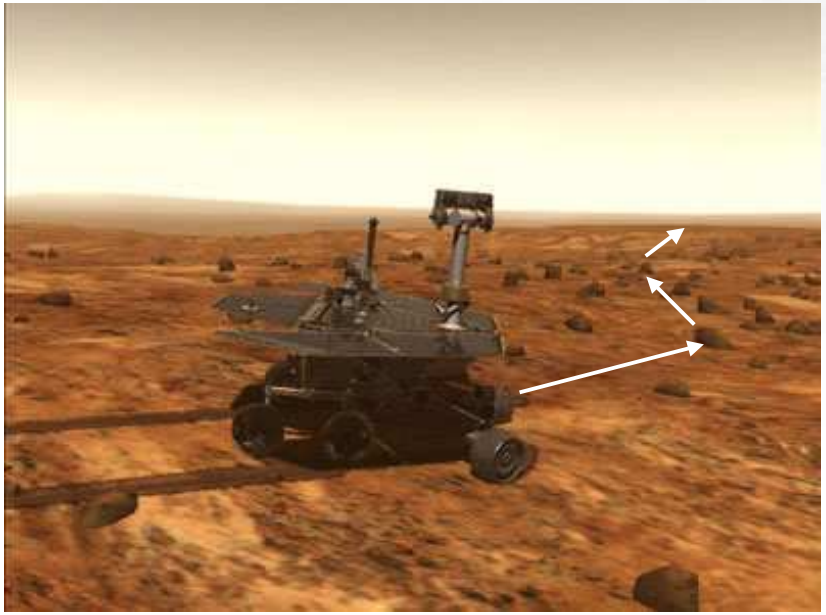
Desired System Characteristics

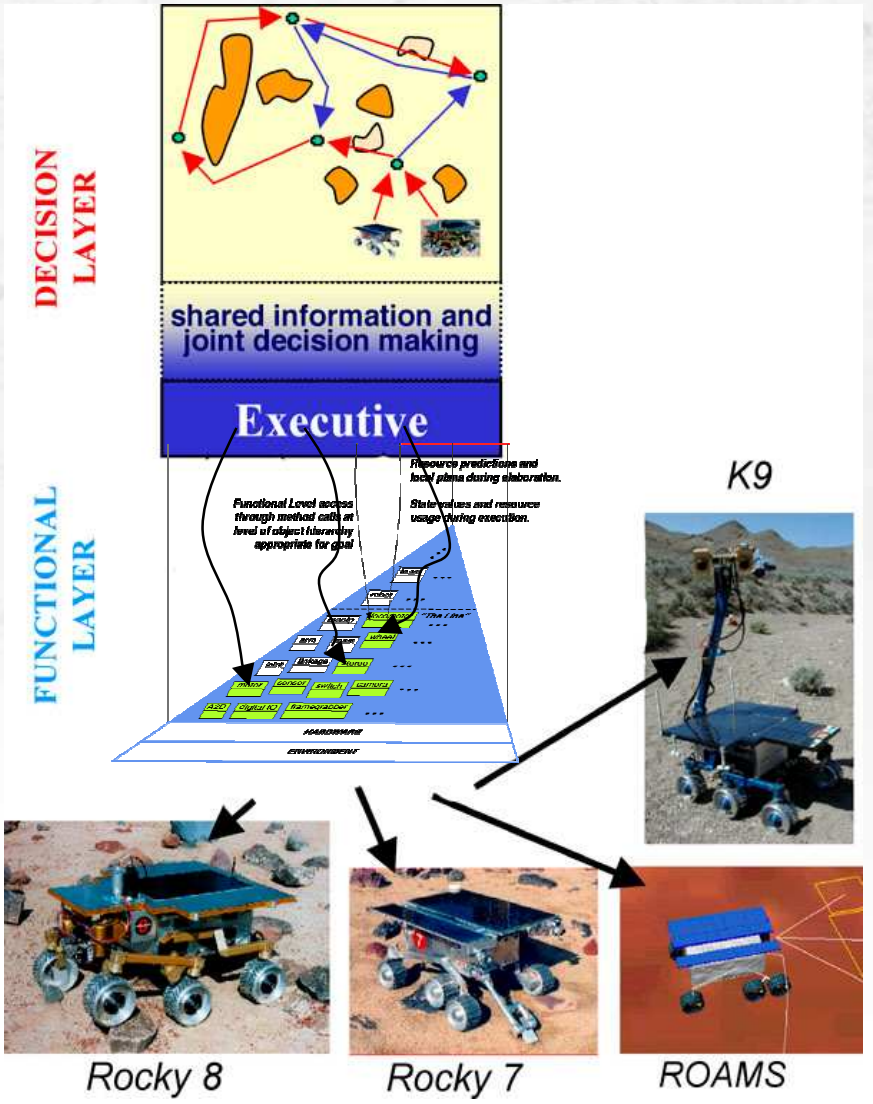


Autonomy for Mars Mission Operations

Mars surface exploration requires autonomous capabilities to overcome constraints of long Mars-Earth communication times

Developing technologies to:
- Dynamically plan rover traversals
- Autonomously place sensors
- Test & integrate autonomy software

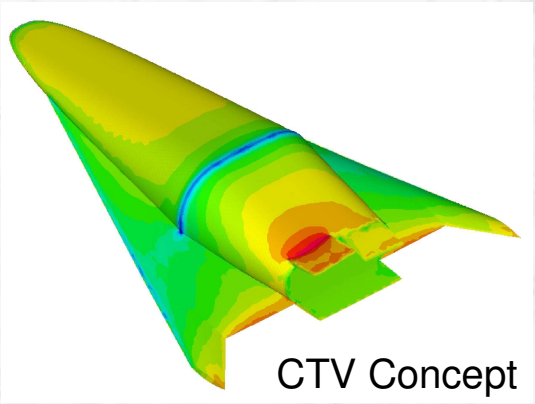




Pilot-in-the-Loop
Redesign of Aerospace Vehicles

Insert early pilot evaluation of vehicle handling characteristics into to aerospace vehicle design

During simulation entry:
- Evaluate aero/control performance (CFD-based)
- Control system modification
- Pilot testing of modified vehicle



CTV Concept

Simulations conducted in Vertical Motion Simulator

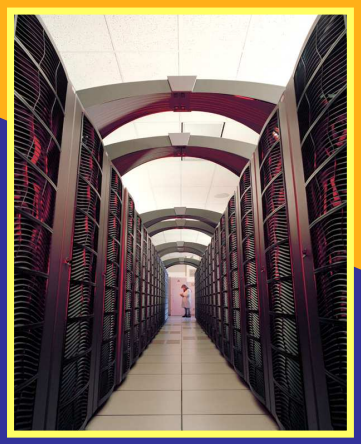
Eight Astronaut participated in the evaluations of the CTV concept

VLAB (Virtual Laboratory) that allows remote sites to collaborate during simulation tests

Support for Returning Shuttle to Flight

Space Shuttle flights were on hold due to fuel liner cracks. Flights have resumed, but cracks still under study. OAT supporting Shuttle Program efforts to improve understanding of

- **Cause**
- **Impact to safety**
- **Effects of alternative repair choices**



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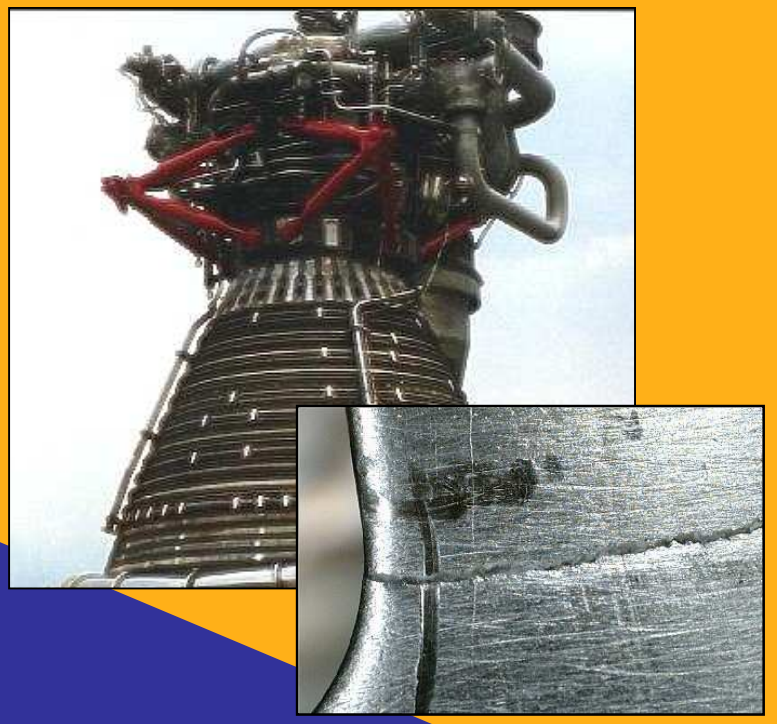
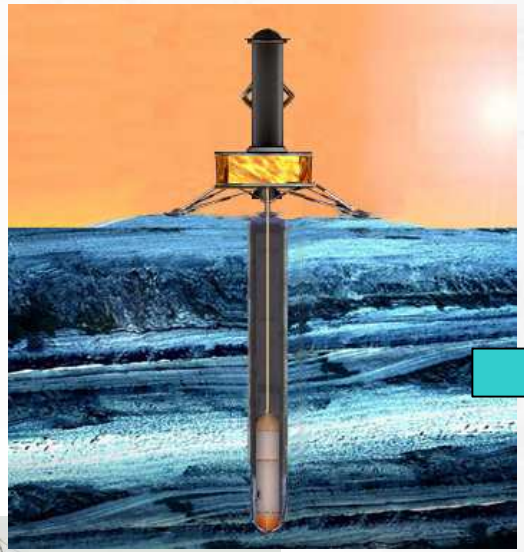
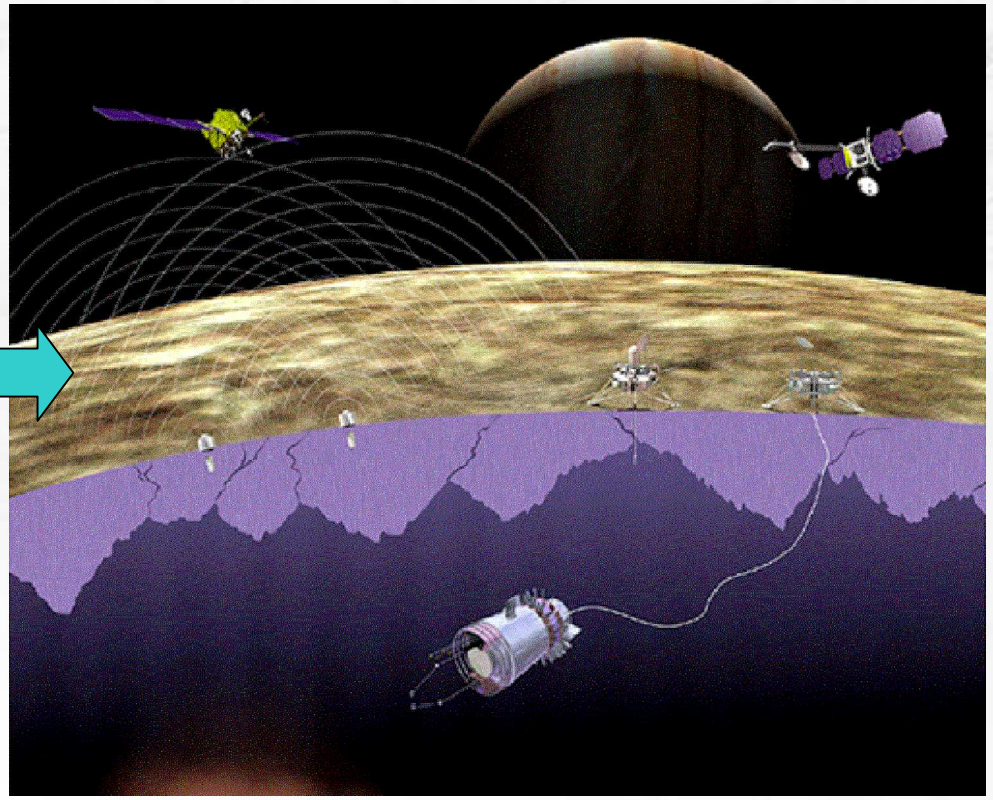


The WARP3D computational fracture mechanics tool was used by MSFC engineers to assess Shuttle flow liner cracks

- **Provided 1.2 million hours of high performance computing**
- **Unsteady fluid dynamics tools and expertise**

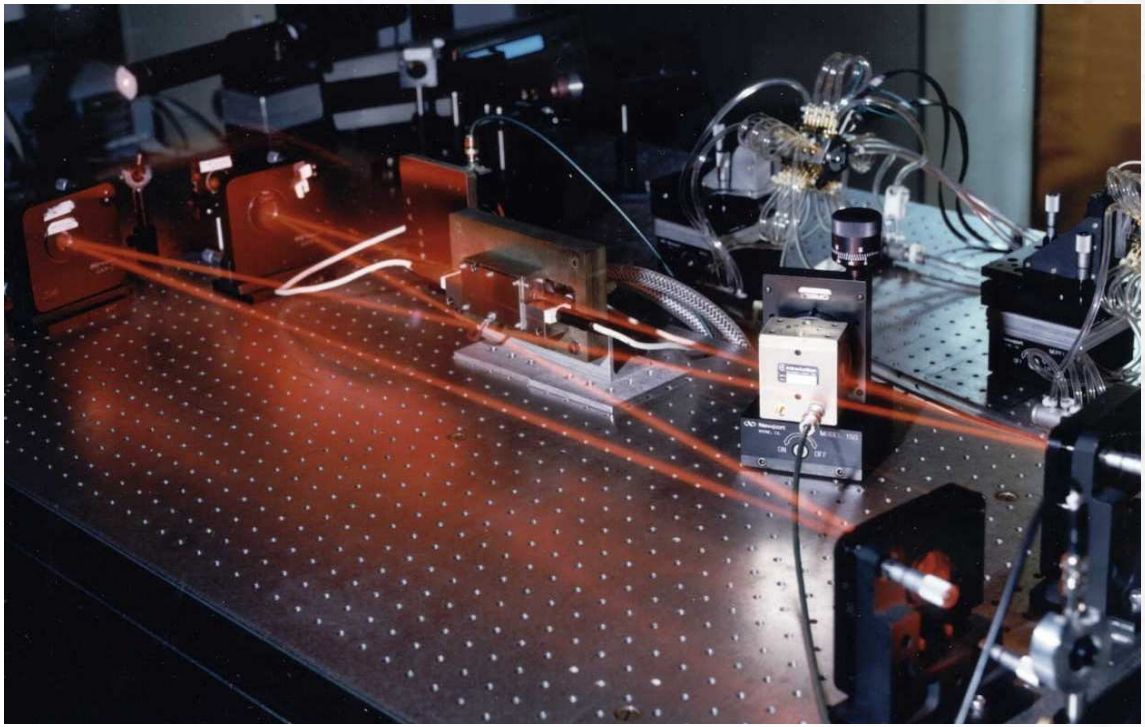
Cryobot Ice Explorer

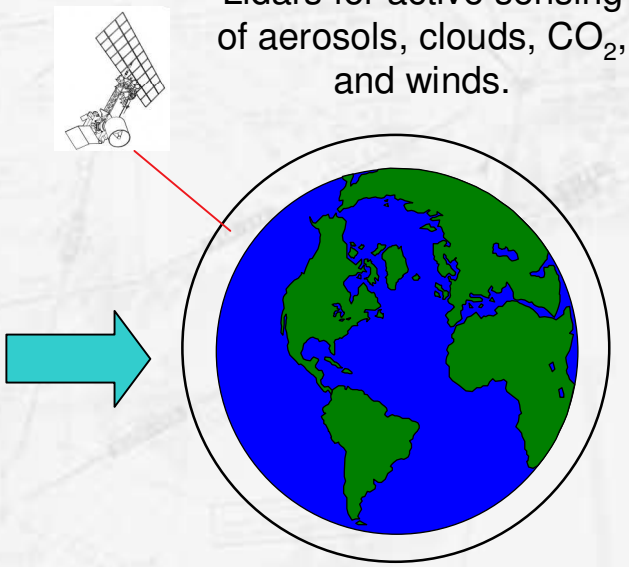




Cryobot Ice Explorer, a self-guiding robot to conduct subsurface ice sampling on planetary bodies, was demonstrated by JPL for the first time on an Arctic glacier. The probe successfully melted through 23 meters of ice. This technology is enabling for mission concepts to search for life in the ocean of Europa or polar regions of Mars.

Tunable Laser Transmitters for Lidar Missions





Proof-of-concept tunable 2-micron laser transmitter.

Investigation Organizer: Mishap Support

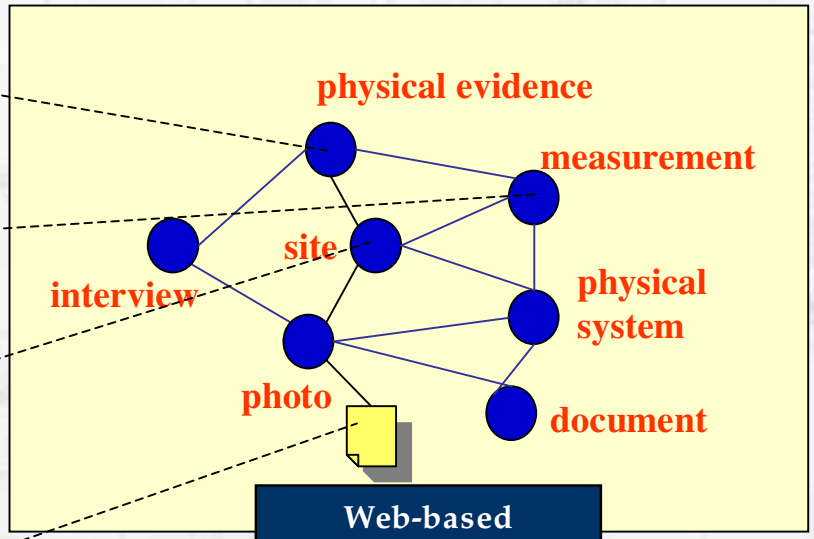
- **Nodes:** ***information resources (describe people, places, systems, records)***

- **Attributes:** ***properties of resources (e.g.,"date, size, format")***

- **Links:** ***relationships among resources (e.g.,"has design record," "has causal model")***

- **Attached files:** ***electronic documents associated with resources***

PROVIDES BETTER CAUSAL ANALYSIS OF FAILURES TO HELP PRIORITIZE FUTURE RESEARCH & IMPROVED SYSTEM SAFETY

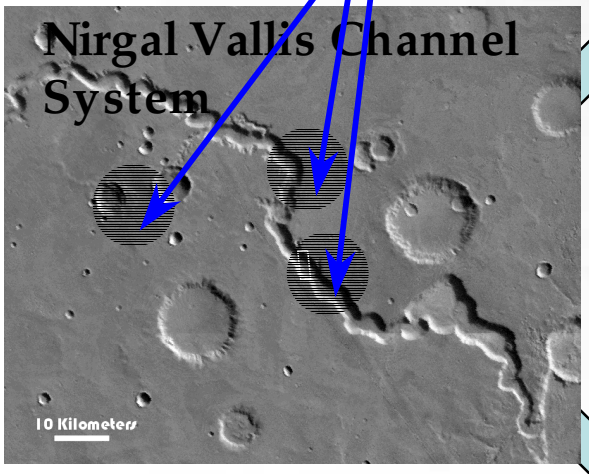


Web-based Collaborative Tool

Better Mishap Analysis

RMCS Technology Risk Management Methodology: Mars Smart Lander Pilot Product

Science Goal: Reach and explore set of predefined science sites



OPTIONS

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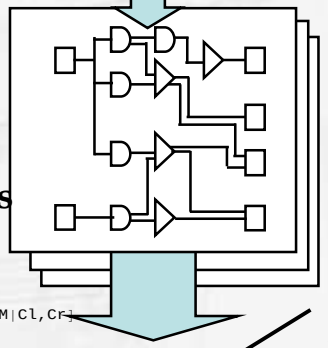
Long Lead Investment Strategies

Technology	Time	Cost	Op Cost	Ped	D
Tech **A**	11	20	19	20	+1
Tech **2A**	21	40	30	35	+5
Tech **2A1**	09	17	20	18	+2
Tech **B**	15	08	08	08	---
Tech **C2**	18	11	07	14	+3
Tech **2C3**	45	66	25	19	+6
Tech **D**	**101**	**53**	**80**	**12**	+12
Tech **D45**	**33**	**16**	**22**	**07**	+18
Tech **E**	**61**	**90**	**105**	**13**	+20
Tech **F**	08	44	41	09	---
Tech **12F5**	57	39	75	91	+8
Tech **15F**	46	80	34	17	+9

Roving capability

Technology Risk Assessments



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Provided key insight for the MSL team on long lead technology investment options

Precision landing capability